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The gaspereau fis[illegible]es (*Alosa pseudoharengus* and *A. aestivalis*) of the Miramichi River with updates on the fishery of the Richibucto River of Gulf New Brunswick, 1997 to 2000

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Abstract

The gaspereau (*Alosa aestivalis*, Blueback herring; *Alosa pseudoharengus*, Alewife) fisheries are regulated by license and season restrictions. Gaspereau catches in 1997 and 2000 decreased in the Gulf New Brunswick region relative to the previous 5-year means but catches were above average in 1998 and 1999. Landings of gaspereau in 1997 and 2000 from the Miramichi River were the lowest since 1984. Reference fishing mortality rates (F) are 0.4 to 0.5 for alewife and 0.4 for blueback herring. In the catches, alewife proportions declined from 65% in 1997 to 17% of the total gaspereau catches (by number) in 1999 and 2000. The 1997 migration of gaspereau was later in the season than for 1998 to 2000. Less than half of the gaspereau stock was available to the fishery in 1997 compared to 63% to 80% during 1998 to 2000. The estimated fishing mortality rates on alewife have generally been above reference levels every year since 1982 and were highest in recent years. Exploitation rates on blueback herring have been closer to the reference levels although increasing since 1993. Both alewife and blueback herring in these fisheries are harvested primarily at the recruit stage. Based on the apparent weakness of the 1996 and 1997 year classes for both alewife and blueback herring, abundance in 2001 is not expected to be high. The limited age distribution of both alewife and blueback in the Richibucto River catches and the absence of fish older than 6 years, indicate that the status of the gaspereau stocks is similar to that of the Miramichi River with exploitation rates above reference levels.

Résumé

Les pêches au gaspareau (*Alosa aestivalis*, Alose d'été; *Alosa pseudoharengus*, "Gaspareau") sont gérées par des contraintes de permis et de saisons. Les débarquements de gaspareau provenant du sud du Golfe Nouveau-Brunswick en 1997 et 2000 étaient inférieurs à la moyenne des cinq années précédentes mais les débarquements en 1998 et 1999 étaient supérieures à la moyenne. Les seuils de références de taux de mortalité de pêche (F) se situent entre 0,4 et 0,5 pour le "gaspareau" et 0,4 pour l'alose d'été. La proportion de "gaspareau" dans les débarquements est passée de 65% en 1997 à 17% durant 1999 et 2000. La migration de gaspareau en 1997 était décalée par rapport aux années 1998 à 2000. Les taux de mortalité de pêche annuels sur le "gaspareau" ont généralement été supérieurs au taux de référence depuis 1982 et en augmentation durant les dernières années. Les taux de mortalité de pêche ont fluctué autour du niveau de rérérence pour l'alose d'été mais sont en augmentation depuis 1993. Les deux espèces sont exploitées majoritairement au stage de nouvelles recrues. En conséquence de la faible abondance des cohortes de 1996 et 1997 des deux espèces, on s'attend à une faible abondance de gaspareau en 2001. La distribution d'age contrainte de "gaspareau" et alose d'été dans les débarquements de la rivière Richibucto ainsi que l'absence de gaspareau plus vieux que 6 ans indiquent que l'état de ces stocks n'est pas meilleur que celui de la rivière Miramichi avec des taux d'exploitation vraisemblablement supérieurs aux niveaux de référence.

INTRODUCTION

There are three species of anadromous clupeids which utilize the numerous rivers in the Gulf of St. Lawrence for spawning: the American shad (*Alosa sapidissima*), the alewife (*Alosa pseudoharengus*) and the blueback herring (*Alosa aestivalis*). All three species are fished commercially throughout the Gulf of St. Lawrence (Chaput and LeBlanc 1991); the alewife and the blueback herring are reported in the landings under the common name gaspereau. Gaspereau landings in the Gulf rivers of the Maritime provinces peaked in the mid-1950s with reported landings of over 14,600 t in 1952 and declined rapidly afterwards to a low of 920 t in 1969 (LeBlanc and Chaput 1991). Since then, catches peaked at just under 7,100 t in 1980 and have averaged over 5,000 t since 1978 (Chaput 1995).

Both alewife and blueback herring spawn in all the rivers of the Gulf shore of the Maritimes (Chaput and LeBlanc 1991) but the relative abundance of each species varies with the river. For example, alewife represent more than 95% of the spawning run of gaspereau to the Margaree River whereas in the Miramichi River, blueback herring are more abundant than alewife (Chaput and LeBlanc 1991; Chaput and Atkinson 1997). The alewife migration occurs about ten days to two weeks before the blueback herring migration and gaspereau arrive progressively later in the spring in an east to west direction (Chaput and LeBlanc 1991). Gaspereau overwinter outside the Gulf of St. Lawrence, along the Atlantic coast of Nova Scotia (Crawford and Tully 1989).

Annual assessments of the Miramichi River gaspereau fishery have been prepared since 1983 (Alexander and Vromans 1983 to 1988, Chaput and LeBlanc 1989, LeBlanc et al. 1990). A bi-annual assessment was presented for the 1991 and 1992 fisheries (Mowbray et al. 1993); 1995 and 1996 fisheries (Chaput and Atkinson 1997) and the 1993 and 1994 fisheries were assessed and summarized in Anon. (1995). Other rivers have been studied and assessed intermittently since the 1970's: Pokemouche River (district 67) and Tracadie River (district 68) in 1974, 1989, 1990, and 1994 (Peppar and Pickard 1976; LeBlanc et al.1991; Anon. 1995), Richibucto River (district 76) in 1989, 1990, and 1994 to 1996 (LeBlanc et al. 1991; Anon. 1995; Chaput and Atkinson 1997), and the Kouchibouguac River and Black River (district 75) for 1989 to 1993 (Tremblay et al. 1994).

The assessment of the gaspereau fishery of the Miramichi River has in the past highlighted the following considerations for management:

1 - the gaspereau fishery historically opened May 15 and closed June 15. As a consequence, alewife were exploited more intensely than blueback herring because the alewife migration begins in mid-May whereas the blueback herring migrate to the Miramichi from late May through June.

2 - bycatch of striped bass early in the season and bycatch of Atlantic salmon at the end of the season has constrained the opening and closing periods.

3 - general freeze on licenses and effort with the exception of the introduction of four new trapnet licenses to the Eel Ground First Nation (two in the Northwest Branch of the Miramichi and two in the Southwest Branch of the Miramichi) in 1995.

There is less historical information on the status of gaspereau in rivers other than the Miramichi. On the basis of the distribution of age classes in the gaspereau fisheries of the other smaller river systems of Gulf New Brunswick, it appears that the fishery exploitation has been more intensive than on the Miramichi River.

The following document provides a description of the 1997 to 2000 fisheries of the Miramichi River in terms of the harvests, timing of the fishery, species composition, and age distribution in the catches. Biological attributes of the gaspereau in the commercial catches are compared to those sampled from research trapnets upstream of the fishery. Similar data are analyzed for the 1997 to 2000 fisheries of the Richibucto River and compared to findings from previous years.

DESCRIPTION OF FISHERIES

The gaspereau fisheries are regulated by license and season. There is a freeze on new commercial licenses in Gulf New Brunswick. The seasons in 1997 to 2000 varied by district and river and were essentially similar to previous years (Fig. 1).

Year	Location	Season dates
1997	Miramichi	19 May - 23 June
	Richibucto	26 May - 30 June
1998	Miramichi	18 May - 20 June
	Richibucto	25 May - 28 June
1999	Miramichi	18 May - 19 June
	Richibucto	24 May - 24 June
2000	Miramichi	18 May - 21 June
	Richibucto	18 May - 21 June

For the Miramichi, the first two weekends of each season were closed to fishing from Saturday noon until Sunday 18:00

Landings

Landings are available from purchase slip and supplementary 'B' forms compiled by Statistics Branch of DFO (Table 1). Purchase slips are completed by buyers. Supplementary 'B' forms are completed by DFO field officers monthly and are estimates of the catch of gaspereau which was used locally for bait or other purposes. These catches are not sold to buyers and would not normally be recorded in the purchase slip database. Between 1978 and 1987, the proportion of the total reported landings compiled by Statistics Branch which were transcribed from purchase slips averaged 88% for the Miramichi River fishery and 72% for the southeast New Brunswick districts (Chaput and LeBlanc 1991).

A second source of catch data is the voluntary logbook program (Table 2). Daily catch and effort logbooks are completed by varying numbers of fishers in any year - the largest participation historically has been from the Miramichi River fishery but the participation rate in this fishery has also been dramatically reduced. There is consideration

being given to the establishment of mandatory logbooks in the gaspereau fisheries of Gulf New Brunswick.

During 1990 to 1996, landings were intermittently compiled by the "Spring herring and gaspereau coordination committee". Monitors would obtain the catch values from the buyers on a daily basis or every second day. The catches compiled by the coordination committee were frequently different from the DFO compiled landings; generally DFO catches were less than the coordination committee values. There is no obvious explanation for the discrepancy (Chaput and Atkinson 1997). The purchase slip data were used in the assessment for estimating the catch at age from the fisheries.

The landings of gaspereau for the Gulf New Brunswick statistical districts and for all of the southern Gulf for the period 1978 to 2000 are summarized in Table 1. The data for 2000 are preliminary. Gaspereau catches in 1997 and 2000 were down in the Gulf New Brunswick region relative to the previous 5-year means but catches were above average in 1998 and 1999. The preliminary harvests for 2000 are the lowest reported during 1978 to 2000 (Table 1). Landings of gaspereau in 1997 from the Miramichi River districts (71 and 72) were the lowest since 1984 and more than 60% below the previous five-year average. Similar low landings were registered for the Miramichi in 2000.

Whereas landings in 1997 were low in the Miramichi districts, landings were among the highest ever in districts 73-75 and district 76 (Richibucto) (Table 1). The fishermen in the Miramichi attributed the low catches in 1997 to a disruption in the migration of gaspereau resulting from construction work on the north side Miramichi waste water treatment facility. High catches in the Richibucto district were considered to have been a consequence of Miramichi gaspereau being deflected away from the Miramichi to Northumberland Strait rivers. The low landings of 2000 were reported in districts 66-70 (north of Miramichi) and the Miramichi fishery.

REFERENCE POINTS

The management of the gaspereau fishery has in the past been based on ensuring that the overall fishing mortality rate (F) does not exceed the target fishing mortality rate defined at $F_{0.1}$. The $F_{0.1}$ reference point has been used in numerous fisheries as a target reference point and is defined as the fishing mortality rate at which the slope of the line tangential to the yield per recruit curve is 10% of its slope at the origin (Anon. 1998). The fishing mortality rates at $F_{0.1}$ are derived from a yield per recruit analysis and equate to F = 1.05 for alewife and F = 1.01 for blueback herring (LeBlanc et al. 1991). These instantaneous rates translate to annual fishery removals of about 65% of the fishery recruited (spawning run) population in a given year. This high value stems from the estimated high natural mortality rate (M) for mature spawning gaspereau of 0.44 for first time spawners and 1.05 for all subsequent spawning years (Chaput and Alexander 1989).

Chaput and Atkinson (1997) reviewed the derivation of reference points for gaspereau and in keeping with recent literature, suggested the reference point F should be reduced below those derived from $F_{0.1}$ objectives. Walters and Pearse (1996) suggested that F_{opt} (defined as the optimum fishing rate based on the long-term objective of maximizing a logarithmically risk-averse function of catch) is less than two-thirds $F_{0.1}$ of harvestable fish.

The natural mortality rate (M) of alewife or blueback herring is poorly defined. Chaput and Alexander (1989) provided estimates of M for one alewife stock from South River (NS) and suggested that M was higher on repeat spawners than on first time spawners. The value of M for first time spawners averaged 0.44 (36% annual rate). Life history methods from the literature have been proposed to provide relative indicators of plausible values of M. The empirical relationship between longevity and natural mortality derived by Hoenig (1981) suggests M of about 0.4 based on the observed maximum spawning ages of eleven years for alewife and twelve years for blueback herring (Chaput and Alexander 1989). Jensen (1996) reviewed three life history relations called the Beverton and Holt invariants, one of which provides an indication of the natural mortality on the basis of the mean age at maturity ($M * m = C1$; where M = natural mortality, m = mean age at maturity, and C1 = 1.65 or 2). The mean age at maturity of alewife in the Miramichi River (based on the proportion of the recruitment to the river which matures at age 3 years versus 4 years) is about 3.4 years. Blueback herring have a slightly older mean age at maturity of 3.9 years. These inputs provide estimates of M equal to 0.49 for alewife and 0.42 for blueback herring.

Walters and Maguire (1996) suggest that given the uncertainty of estimating and forecasting stock size, the fishing mortality should remain below M. In keeping with this prudent approach, reference fishing mortality rates for the gaspereau fishery of the Miramichi should therefore be in the order of 0.4 to 0.5 for alewife and 0.4 for blueback herring.

ASSESSMENT DATA

The data used in the assessment of the Miramichi River include logbook reports from individual fishers, two-stage stratified sampling for age composition and derivation of the catch at age, and sampling at index trapnets in the Northwest and Southwest branches of the Miramichi River. Only two-stage stratified sampling for age composition and catch-at-age were conducted for the Richibucto River in 1997 to 2000.

Fishery logbooks are used to make inferences on timing of the catch and in the past have been used as an abundance index (Mowbray et al. 1993). Logbook data are available from the Miramichi for 1982 to 2000. Logbook data from other rivers have not been available in recent years.

Commercial sampling followed a similar procedure to that used since 1989 (Chaput and LeBlanc 1990). Sampling was conducted weekly at the three main landing locations:

twice a week at the Loggieville wharf, and three times a week at the Chatham and Newcastle wharves (Fig. 1; Table 3). For the Richibucto River, two-stage sampling was conducted two or three times during the season but gaspereau were not identified to species in the first phase of sampling. A sample of about 70 kg was obtained from an individual fisher's catch. Lengths were obtained by species (alewife and blueback herring). Fish were kept for detailed sampling (length, weight, species, sex, maturity, gonad weight of females, scales collected for ageing) using the following protocols: three fish for every 5 mm fork length group up to 280 mm and 5 fish for every 5 mm group for fish longer than 280 mm. Scales were interpreted for total age and age of first spawning.

When detailed samples were frozen prior to analysis, fresh fish lengths were estimated from frozen lengths using the following relationship (Chaput and LeBlanc 1989):

adjusted length (mm) = 1.0143 X frozen length (mm) + 4.557

Scales for age determination were collected preferentially from the left side, midway between the dorsal fin and the ventral scutes. Species (alewife, *Alosa pseudoharengus*; blueback herring, *Alosa aestivalis*) were identified on the basis of the external appearance and the peritoneum colour (Scott and Crossman 1973). The peritoneal lining of alewife tends to be pale to dusky whereas the lining of the body cavity of blueback herring is sooty to black.

The catch-at-age of alewife and blueback herring was derived from age-length keys (Table 3) applied to length sampling vectors. Length vectors within each group were weighted by the daily landings from the area as recorded on purchase slips. Catch-at-age was first derived for each area, summed and adjusted for the total harvests from the river.

Estimates of cohort size were obtained from the catch-at-age assuming M = 0.4 and that all fish of the last age seen were fished out. This provides maximum estimates of F (at assumed M) for each fishing year.

The catch-at-age for the other rivers was determined using one age-length key per river applied to the length frequency samples from the fishery. The catch-at-age for these rivers was not weighted by the landings but provides an indication of the relative age structure in the catch. Proportions of alewife and blueback herring in the fishery are determined from the proportions in the length samples.

Annual counts of gaspereau are available from the DFO index trapnet at Millbank (up to 1992) and from the index trapnets in the Southwest and Northwest branches for 1992 to 2000. A trapnet was operated in the Southwest Miramichi at Millerton between 1995 and 2000, about 10 km above the confluence of the two branches of the river. These data provide an indication of the relative abundance of gaspereau, timing of the run and proportion of total run available to the fishery. Sampling for length and species composition was conducted at the index trapnets every second day during the entire migration period of gaspereau. Abundance at length by species was obtained by weighting the length/species vectors by the daily estimates of gaspereau catch.

ASSESSMENT RESULTS

Miramichi River

Alewife return to the Miramichi generally ten days before blueback herring. In 1997 to 2000, blueback herring were only observed after June 1 and equal proportions of alewife and blueback herring were observed in the catches by June 13 in 1997, June 4 in 1998, June 2 in 1999 and 2000 (Fig. 2). In 1997 and 1998, the proportion alewife was higher in the Northwest Miramichi fishery (Newcastle) than at the other two locations (Chatham and Loggieville) which fish in the main Miramichi, downstream of the confluence of the Northwest and Southwest branches (Fig. 2).

Alewife have comprised varying proportions annually of the overall gaspereau catches from the Miramichi (Fig. 3). Alewife were the dominant proportions (greater than 60%) of the catches from 1990 to 1994 but declined to 17% of the total gaspereau catches (by number) in 1999 and 2000 (Fig. 3; Table 4). In other years, blueback herring have only been the dominant component of the catches in 4 of 17 years prior to 1999 but were by far the most important component (at 83% of the catch by number) in 1999 and 2000 (Fig. 3; Table 5). The higher catch of alewife relative to blueback herring in 1990 to 1994 was attributed to the delayed migration of gaspereau in those years and the closure of the fishery on June 15, soon after the start of the blueback migration (Chaput and Atkinson 1997).

First time spawners have been the dominant age component of the alewife harvests in the Miramichi fishery; at or greater than 75% of the alewife catches in 11 of 19 years (Fig. 3; Table 4). The dominant cohort in the annual fishery has represented between 35% and 89% of the total catches with only a few cohorts at low relative abundance (never dominant): 1980, 1982, 1986, 1992 and 1993) (Table 4). Four year old alewife are generally the most abundant age group in the catches (13 of 19 years) with three year olds as the second most dominant age group (5 of 19 years) (Table 4; Fig. 4). In 1996, for the first time, five year old fish were the dominant age group (Table 4; Fig. 4).

First time spawners made up smaller proportions of the blueback herring harvests; varying between 0.17 and 0.95 during the 1982 to 2000 fisheries (Table 5; Fig. 3). The highest ever proportions were observed in 1997 to 1999 (Fig. 3). Four year olds tend to be the most commonly abundant age group in the catches (10 of 19 years) but in contrast to alewife, five and six year old fish have frequently dominated the catches (7 of 19 years) while three year olds have only been dominant in one year (1998) (Table 5; Fig. 4). In 1982, the dominant age group in the fishery was 7-year old blueback herring (Table 5; Fig. 4). Several cohorts have never been the dominant age group in the fishery: 1976 to 1978, 1982, 1985 and 1986, 1989, 1992, and 1994.

Previous spawner (older) gaspereau tend to return to the river before new recruits. This pattern has been consistent every year and is most noticeable in the change in lengths over the duration of the fishery. Alewife and blueback herring lengths decreased

progressively over the season (Fig. 5). Blueback herring are generally smaller than alewife (Chaput and Atkinson 1997), a characteristic which was consistent in 1998 to 2000 and evident in both the commercial catches and the catches at the research trapnet in the Southwest Miramichi (Fig. 5).

Research indices of abundance

Catches of gaspereau at Millbank and at the trapnets in each branch of the Miramichi provide alternative indicators of abundance over time. Abundance of gaspereau in the Miramichi was high between 1976 and 1980, decreased and stayed relatively constant from 1981 to 1988 and declined again from 1989 to 1991 (Table 6). Counts for seven years from the Northwest index trapnet suggest that abundance was extremely variable over time. Gaspereau were very abundant in 1992 but much less so in 1987 and 1994. At the Southwest index trapnet, abundance was high in 1985, 1987 and 1995. The 1996 count of gaspereau at the Millerton trapnet (about 10 km upstream of the Enclosure trapnet) was less than half the 1995 count, but catches in 1998 and 1999 were the highest of the short time series. At Millerton, catches in 2000 were the lowest. These counts correspond to the reported catches of gaspereau in the Miramichi commercial fishery from 1995 to 2000, with the exception of 1997 when fishery catches were low compared to counts at the research trapnet (Table 6).

Timing of the fishery

Catches in the fishery since 1990 have occurred later than what was considered normal in the 1980's, with only 50% of the recorded logbook catch landed by June 12 in all three fishing areas (Fig. 6). The timing of the landings in 1993 to 1996 was among the latest; this was expected since the fishery closure dates were later in those three years (June 19 in 1993, June 18 in 1994, June 20 in 1995 and 1996). The delayed catches since 1990 occurred in all three areas, Loggieville, Chatham and Newcastle and generally continued into 2000, compared to the 1980s (Fig. 6). In 1998 and 1999, the catches occurred earlier than in any other year in the 1990s.

Delayed migration of gaspereau was not as evident at the DFO Millbank trapnet, in terms of when 50% of the gaspereau were counted (median date), but the first part of the run was later than all other years in 1990 to 1992 and in 1985. Catches at the DFO index trapnet in the Northwest Miramichi indicate that the gaspereau migrations from 1992 to 1995 were later than those from 1985 to 1987 by about ten days, similar to the logbook catch data for those years. Even in 1985, which was a late year in the commercial fishery, the migration was earlier than from 1992 to 1995. The migration of gaspereau in 1997 was about ten days later than the migrations in 1998 to 2000; the median date of catches at the Southwest Miramichi trapnet was June 23 in 1997 compared to June 13 to 15 from 1998 to 2000 (Fig. 7).

The fishery had access to variable proportions of the total gaspereau spawning migration. Only about 60% of the total gaspereau enumerated at Millbank were counted during the gaspereau fishing season and in some years, as little as 10% to as much as 50%

of the gaspereau run was counted after the closure of the fishery (June 15 in most years) (Chaput and Atkinson 1997). In 1995, over half of the annual count of gaspereau occurred after June 20 when the fishery closed, while in 1996, 25% of the gaspereau catches at the Southwest Miramichi trapnet occurred after the fishery closed. The 1997 migration of gaspereau was late compared to that of 1998 to 2000 and this is reflected in the proportion of the gaspereau migration which was available to the fishery; less than half in 1997 compared to 63% to 80% of the total runs from 1998 to 2000.

	Proportion alewife in		Proportion of catches at the trapnet occurring after the commercial fishery closure		
Year	Commercial	SW Trapnet	Alewife	Blueback	Both Species
1997	64%	12%	27%	59%	55%
1998	45%	5%	3%	39%	37%
1999	17%	3%	3%	25%	25%
2000	17%	23%	12%	22%	20%

A greater proportion of the alewife run compared to blueback was available to the fishery, especially so in 1998 and 1999.

State of the Stock

Backward cohort summation provides a reconstruction of the runs of gaspereau to the Miramichi River from 1982 to 1996 (the 1995 and 1996 estimates are incomplete). Under the assumption of M = 0.4, the returns of alewife to the Miramichi River increased from about 3 million fish in 1982 to 9 million fish between 1991 and 1994 (Fig. 8). The indications are that the abundance of alewife declined in 1995 and 1996. Blueback herring abundance peaked in 1987 and 1988 at over 15 million fish but had declined to about 6 million fish from 1990 to 1993. Returns in 1994 and 1995 improved to about 9 million fish (Fig. 8). The spawning escapement has followed a similar trend to the returns but the alewife escapement declined to less than 2 million fish from 1993 to 1996 (Fig. 8). Blueback herring escapement has been about 3 million fish since 1990.

The estimated fishing mortality rates on alewife have generally been above the reference point F of 0.4 to 0.5 every year since 1982 and have been very high in recent years (Fig. 8). Exploitation rates on blueback herring have been closer to the reference level of 0.4 although increasing since 1993. Previous assessments indicated that the fishing mortality on alewife was much higher than on blueback herring. This would be even more relevant since 1990 because of the delayed migrations. In the 1980's, alewife were harvested in large part in May while blueback herring were captured in June.

There continues to be fewer age-classes in the alewife spawning run compared to the blueback herring and this is considered indicative of higher exploitation on the alewife. The fishery also harvests a higher proportion of new recruit alewife relative to new recruit blueback herring, although in the 1990s the blueback catches had also been comprised of high proportions of new recruitment.

Only a few strong year classes of alewife have been produced in the Miramichi River: 1983, 1987, 1988 and 1990 (Fig. 9). There have been at least three notable year class failures (abundance less than 2 million recruits to the fishery): 1986, 1992 and 1993, with the 1996 year class showing indications of being very weak (Fig. 9).

There have been two very abundant year classes of blueback: 1983 and 1995 (Fig. 9). Year class failures (abundance less than 2 million recruits to the fishery) in blueback include 1992, 1993 and seemingly 1996 (Fig 9). With the exception of the two very large blueback year classes, alewife were equally abundant in the Miramichi as blueback herring.

Chaput and Atkinson (1997) indicated that in 1995, the fishery harvested alewife and blueback disproportionately to the relative size of the runs. Alewife comprised 37% of the total harvest (by number) while they constituted only 15% of the total gaspereau migration to the river. The estimates for the total run were based on counts and samples at the Southwest Enclosure and Northwest Enclosure trapnets. In addition, Chaput and Atkinson (1997) indicated that alewife were exploited in direct proportion to their abundance at size (fork length) while larger blueback herring were exploited more heavily than the smaller, younger aged fish.

A comparable analysis for 1997 to 2000 produced similar results. With the exception of year 2000, alewife were a greater proportion of the total gaspereau catches than the proportion in the overall spawning migration (Fig. 7; text table above). Alewife length distributions in the fishery are similar to those at the research trapnet but blueback length distributions in the fishery are skewed to the larger sized fish compared to the size distribution in the overall run (Fig. 10). The exception is year 2000 where larger alewife and blueback herring were observed at the trapnet relative to the fishery catches (Fig. 10). These patterns are consistent with the differences in migration timing of alewife and blueback herring and the fixed closing date for the fishery which occurs generally after the alewife migration upstream is complete but before the completion of the blueback migration.

The differential exploitation patterns described above are based on the species and size distributions at the Southwest Miramichi research trapnet (Millerton). Samples collected from a similar trapnet in the Northwest Miramichi in 1999 suggest that there is differential species composition between the Northwest and Southwest branches with a relatively larger blueback migration in the Southwest than in the Northwest (Fig. 7, 11). Further sampling is required to determine the extent of the differences between the two main branches of the Miramichi.

Richibucto River

The harvest of 220 t from the Richibucto River in 1999 was the lowest recorded between 1981 and 2000 (Table 2). There have been three years of above average harvest (greater than 1000 t): 1984, 1986, and 1997. Alewife have been the dominant component of the harvests, varying between 70% and 99% in the nine years sampled (Fig. 12). There were generally only four age classes in the annual harvests and no alewife older than six years have ever been sampled (Fig. 12). Three and four year old alewife are the dominant age groups in the harvests. Blueback herring are similarly represented by few age groups; seven and eight year old blueback have occasionally been sampled from this river, although not in recent years. As in the Miramichi River, alewife and blueback herring catches are comprised mostly of new recruits.

In recent years, the limited age distribution of both alewife and blueback in the Richibucto River catches and the absence fish older than 6 years, indicate that the status of the gaspereau stocks is similar to that of the Miramichi River with exploitation rates above reference levels.

PROSPECTS

For the Miramichi River fishery, the 1994 and 1995 year-classes appear strong but the incoming 1996 and 1997 year-classes appear weak. For blueback herring, the 1995 year class is strong although the 1996 and 1997 year classes appear weak. Because both alewife and blueback herring in this fishery are harvested primarily at the recruit stage, there are no reliable indicators of incoming year-class strength. Based on the apparent weakness of the 1996 and 1997 year classes for both alewife and blueback herring, abundance in 2001 is not expected to be high.

For the Richibucto River, exploitation rates are assumed to be higher than in the Miramichi and the prospects are not more positive than for the Miramichi.

MANAGEMENT CONSIDERATIONS

Exploitation rates estimated from backward cohort summation for the 1982 to 1996 Miramichi fisheries generally exceeded the reference fishing levels. The freeze on licenses should be continued.

There is no evidence to indicate that the stocks of gaspereau are distinct in the two branches but gaspereau do show strong affinity to their natal river and this would be the appropriate assumption to make for the Miramichi. Limited sampling at research trapnets in each branch suggests different relative abundance of the two species. Of the 34 trapnets licensed for the Miramichi River, 15 are located in the Northwest Branch of the river. The Southwest Miramichi gaspereau are exploited only when passing through the main Miramichi River. To relieve pressure from the Northwest run, some effort should be

displaced further downriver, where the mixed runs can be exploited, or into the Southwest Miramichi. The weekend closures in May should be maintained to reduce the exploitation rate on alewife. If exploitation rates on blueback herring rise above recent years'levels, then weekend closures in June should be reconsidered.

RESEARCH RECOMMENDATIONS

Presently, no estimates of fishing mortality are available. Methods to assess trends in fishing mortality over time such as those dealing with abundance at length (Sinclair et al. 1993) should be considered.

There is no evidence of distinct runs between the Northwest and Southwest Miramichi. Sampling from trapnets further upriver should be considered to address this question. Sampling at the DFO index trapnets should be conducted to characterize more appropriately the spawning run into alewife and blueback herring. Sampling at these trapnets provides a better description of the gaspereau spawning populations, because the fishery closes before the entire run of gaspereau is over.

Logbooks provide useful data regarding timing and abundance over time. As of 2001, fishers will be required, as a condition of license, to complete and return logbooks recording daily catches of all species.

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Table 1. Landings (tons) of gaspereau from the southern Gulf of St. Lawrence, 1978 to 2000. Data summarized from purchase slip and Supplementary "B" slips collated by Statistics Branch, DFO. The year-mean/mean is the percent change for the year from the previous five-year mean.

	New Brunswick Statistical Districts						Southern Gulf			
Year	63-65	66-70	71-72	73-75	76	77-80	NB	NS	PEI	Total
1978	1	781	1434	200	566	102	3084	1911	104	5099
1979	33	413	3343	343	213	63	4409	2023	405	6837
1980	105	237	3767	219	237	111	4676	2167	253	7097
1981	320	128	1411	143	564	141	2708	1653	259	4620
1982	45	150	1278	193	314	14	1994	1664	133	3790
1983	9	226	1088	123	392	62	1901	780	36	2717
1984		205	666	197	507	143	1717	1052	88	2857
1985	5	465	1342	136	1427	193	3569	3203	238	7011
1986		294	1171	45	398	353	2261	974	464	3699
1987		620	2209	141	1152	297	4419	2559	364	7342
1988		481	1888	269	902	174	3714	2835	233	6782
1989	8	630	1682	432	803	127	3681	2116	132	5929
1990		376	1634	326	719	141	3196	1493	84	4773
1991		462	2028	239	588	267	3584	1070	87	4741
1992		539	2451	54	397	13	3454	772	318	4544
1993		521	1971	89	754	238	3573	951	198	4722
1994		521	1935	83	574	133	3246	465	95	3806
1995		343	2335	39	444	70	3230	188	34	3452
1996	0	119	1150	37	469	152	1927	170	53	2150
1997		300	740	240	1276	142	2697	220	107	3024
1998		521	2262	88	548	200	3619	544	52	4215
1999		336	2585	50	221	51	3244	452	93	3789
2000	1	39	785	58	516	213	1612	275	53	1940
1997-Mean/Mean		-27%	-62%	298%	142%	17%	-13%	-57%	-23%	-19%
1998-Mean/Mean		44%	39%	-10%	-22%	36%	23%	37%	-47%	23%
1999-Mean/Mean		-7%	54%	-49%	-67%	-63%	10%	42%	36%	14%
2000-Mean/Mean		-88%	-57%	-36%	-13%	73%	-45%	-13%	-22%	-42%

* 1985 landings for districts 71-72 as per Statistics Branch data are lower than the Science Branch for that year
no landings recorded; 0 means landings less than 0.5 t

Table 2. Landings (t) of gaspereau by river system based on Statistics Branch (P-slip), values obtained by "spring herring and gaspereau coordination committee" (Coord.), and as cumulated from logbook reports (Logbook). Not all fishers completed logbooks in any given year.

	Pokemouche		Tracadie		Miramichi			Richibouctou	
Year	P-Slip	Coord.	P-Slip	Coord	P-Slip	Coord	Logbook	P-Slip	Coord.
1981	43		47		1411		1323	564	
1982	74		29		1278		1108	314	
1983	35		72		1088		829	392	
1984	127		78		666		612	507	
1985	387		79		1857		1496	1427	
1986	273		21		1171		610	396	
1987	519		74		2209		1077	1149	
1988	393		85		1888		691	903	
1989	442		187		1682		1175	803	
1990	291		85	170	1789		1148	720	
1991	337		125	125	2028		1009	589	
1992	431	682	108	71	2451	1917	827	397	
1993	387	182	134	40	1971	1909	1799	754	1133
1994	376		145		1935	2553	1091	574	799
1995	233	227	110	115	2335	2788	552	304	174
1996	52	54	47	45	1150	1356	562	469	397
1997	90		56		683		287	1242	
1998	233		89		2222		1162	548	
1999	42		42		2585		915	220	
2000			5		777		193	516	

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Table 3. Species composition and number of fish measured per sampling date and location of the Miramichi River, 1997 to 2000. Rectangles define samples combined from age-length keys. Shaded samples indicate key overlap.

				Loggieville		Chatham		Newcastle	
Year	Month	Day	Day of Year	Alewife	Blueback	Alewife	Blueback	Alewife	Blueback
2000	5	24	144	239					
		25	145					207	
		30	150	201					
		31	151					224	
	6	1	152			181			
		2	153					203	4
		3	154	186	29	116	48		
		5	156					122	101
		6	157				150		
		8	159						168
		9	160		243		213		
		10	161						188
		11	162			30	187		
		12	163					23	
		13	164	28		25			
		14	165					13	
		15	166			19			
		16	167	15					
		17	168					29	247
		18	169			11	238		
		19	170					17	231
		20	171	10	295	18	235		
		21	172					23	337
1999	May	27	147					267	
		29	149	279					
		31	151			201	2		
	June	1	152					209	20
		2	153	187	94	217	51		
		3	154					110	131
		4	155	129	143	115	136		
		5	156						145
		6	157		278				
		7	158				299		
		8	159					71	223
		9	160	18	286	45			
		10	161					49	270
		11	162			10			
		12	163					43	
		13	164	6		7	298		
		14	165					14	335
		15	166			7	297		
		16	167					5	365
		17	168	10	327	24	311		
		18	169					13	338

Table 3. Species composition and number of fish measured per sampling date and location of the Miramichi River, 1997 to 2000. Rectangles define samples combined from age-length keys. Shaded samples indicate key overlap.

				Loggieville		Chatham		Newcastle	
Year	Month	Day	Day of Year	Alewife	Blueback	Alewife	Blueback	Alewife	Blueback
2000	5	24	144	239				207	
		25	145						
		30	150	201				224	
		31	151						
	6	1	152			181		203	4
		2	153						
		3	154	186	29	116	48	122	101
		5	156						
		6	157			81	150	53	168
		8	159						
		9	160	18	243	19	213	47	188
		10	161						
		11	162			30	187	23	242
		12	163						
		13	164	28	234	25	212	13	221
		14	165						
		15	166			19	162		
		16	167	15	312			29	247
		17	168						
		18	169			11	238	17	231
		19	170						
		20	171	10	295	18	235	23	337
		21	172						
1999	May	27	147					267	
		29	149	279					
		31	151			201	2	209	20
	June	1	152						
		2	153	187	94	217	51	110	131
		3	154						
		4	155	129	143	115	136	137	145
		5	156						
		6	157	32	278	71	299		
		7	158					71	223
		8	159						
		9	160	18	286	45	240	49	270
		10	161						
		11	162			10	310	43	247
		12	163						
		13	164	6	339	7	298	14	335
		14	165						
		15	166			7	297	5	365
		16	167						
		17	168	10	327	24	311	13	338
		18	169						

Table 3 (continued).

Year	Month	Day	Day of Year	Loggieville		Chatham		Newcastle	
				Alewife	Blueback	Alewife	Blueback	Alewife	Blueback
1996	May	20	140	232	0				
		25	145					277	0
		26	146	228					
		28	148			260			
	June	2	153					246	0
		3	154	256	25	227	38		
		4	155					253	17
		5	156	196	84	196	91		
		6	157					152	122
		7	158			168	124		
		8	159					197	65
		9	160	136	182	168	131		
		10	161					190	99
		11	162	89	225	143	166		
		12	163					222	79
		13	164			11	315		
		14	165					120	217
		15	166	76	283	23	306		
		16	167					37	305
		17	168	22	326	22	321		
1997	June	5	156	222					
		6	159					207	0
		10	161	189	27	244	17		
		12	163					193	64
		13	164	131	59	122	80		
		14	165					114	78
		16	167					136	71
		17	168	157	136	129	127		
		18	169					122	98
		19	170	145	126	152	112		
		20	171					181	60
		21	172	54	173				
		22	173			106	167		
		23	174					164	172

Table 3 (continued).

				Loggieville		Chatham		Newcastle	
Year	Month	Day	Day of Year	Alewife	Blueback	Alewife	Blueback	Alewife	Blueback
1998	May	20	140	232	0	.	.	.	.
		25	145	.	.	.	.	277	0
		26	146	228	.	.	.	.	.
		28	148	.	.	260	.	.	.
	June	2	153	.	.	.	.	246	0
		3	154	256	25	227	36	.	.
		4	155	.	.	.	.	253	17
		5	156	[redacted]	84	195	91	.	.
		6	157	.	.	.	.	[redacted]	122
		7	158	.	.	[redacted]	124	.	.
		8	159	.	.	[redacted]	.	197	65
		9	160	136	[redacted]	[redacted]	131	.	.
		10	161	.	[redacted]	.	.	190	99
		11	162	89	[redacted]	143	[redacted]	.	.
		12	163	.	.	.	[redacted]	222	[redacted]
		13	164	.	.	11	[redacted]	.	.
		14	165	.	.	.	.	120	217
		15	166	76	283	23	306	.	.
		16	167	.	.	.	.	37	305
		17	168	22	326	22	321	.	.
1997	June	5	156	222	.	.	.	.	.
		8	159	.	.	.	.	207	0
		10	161	189	27	244	17	.	.
		12	163	.	.	.	.	193	54
		13	164	[redacted]	[redacted]	122	80	.	.
		14	165	[redacted]	[redacted]	.	.	[redacted]	[redacted]
		16	167	[redacted]	[redacted]	.	.	136	71
		17	168	[redacted]	[redacted]	[redacted]	[redacted]	.	.
		18	169	.	.	.	.	122	98
		19	170	145	126	152	112	.	.
		20	171	.	.	.	.	181	60
		21	172	54	173	.	.	.	.
		22	173	.	.	106	167	.	.
		23	174	.	.	.	.	169	172

Table 4. Alewife catch-at-age (number of fish, thousands) from the Miramichi River fishery, 1982 to 2000. Age.FSP = total age.age at first spawning. Total equals total catch at age (all spawning histories).

Numbers of alewife (X 1000)

Age.FSP	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2.2	0	3	0	.	.	.	.	1	3	.	.	.	.	.	7	.	.	.	0
Total 2	0	3	0	.	.	.	.	1	3	.	.	.	.	.	7	.	.	.	0
3.2	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3.3	477	648	1071	768	2346	644	635	214	3833	2335	538	1158	657	16	983	1532	4053	219	197
Total 3	477	651	1071	768	2346	644	635	214	3833	2335	538	1158	657	16	983	1532	4053	219	197
4.2	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4.3	512	234	146	387	286	1441	447	372	28	371	912	497	414	103	16	74	216	83	16
4.4	488	782	553	687	299	1409	620	777	254	2242	1014	1648	4614	2689	262	330	1669	2104	257
Total 4	1000	1016	702	1074	586	2849	1067	1149	281	2613	1925	2143	5028	2792	278	404	1885	2186	273
5.2	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
5.3	1	33	68	57	152	243	404	389	151	41	317	724	213	192	81	11	6	14	14
5.4	130	63	63	113	119	392	309	553	295	106	295	859	60	738	597	17	26	14	48
5.5	.	21	.	.	1	11	88	29	25	64	26	423	94	388	546	7	.	21	112
Total 5	131	117	131	170	272	646	804	971	471	212	638	2005	368	1318	1224	35	32	50	174
6.3	7	.	17	.	.	66	30	146	58	43	23	121	10	9	44	4	.	.	1
6.4	143	40	25	.	16	122	21	217	113	79	22	344	164	72	128	42	0	.	2
6.5	.	16	0	.	.	6	7	32	9	8	.	102	13	25	67	38	.	.	0
6.6	.	.	.	.	.	.	.	.	.	.	.	114	4	.	17	29	1	.	5
Total 6	150	56	42	.	16	194	59	395	180	130	45	680	190	106	256	113	1	.	9
7.3	4	.	.	.	.	.	.	1	16	1	6	.	44	2	2	0	.	.	.
7.4	43	16	.	.	.	25	3	2	26	14	8	.	8	26	1	9	4	1	.
7.5	8	6	.	.	.	.	.	4	12	6	.	.	90	10	2	2	.	.	.
7.6	.	5	.	.	.	.	.	.	.	.	.	.	.	1	.	4	2	.	0
7.7	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	3	1	.	.
Total 7	54	28	.	.	.	25	3	6	55	21	14	.	149	39	5	18	7	1	0
8.3	.	8	.	.	.	.	.	0	2	.	.	.	.	.	.	.	.	.	.
8.4	82	23	.	.	.	.	.	0	1	.	1	.	.	6	.	.	2	.	.
8.5	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
8.6	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total 8	84	34	.	.	.	.	.	0	4	.	1	.	.	6	.	.	2	.	.

Table 4 (continued).

Numbers of alewife (X 1000)

Age.FSP	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
9.3	.	1	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
9.4	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
9.5	.	0	.	.	.	.	.	.	.	.	.	78	.	.	.	.	.	.	.
Total 9	.	12	4	.	.	.	.	.	.	.	.	78	.	.	.	.	.	.	.
10.3	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
10.4	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
10.5	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total 10	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
11.3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
11.4	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total 11	1	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	1897	1924	1950	2012	3219	4358	2568	2735	4825	5311	3162	6064	6392	4277	2753	2102	5979	2456	654
Dominant Cohort	1978	1979	1981	1981	1983	1983	1984	1985	1987	1987	1988	1989	1990	1991	1991	1994	1995	1995	1996
% of Total	53%	53%	55%	53%	73%	65%	42%	42%	79%	49%	61%	35%	79%	65%	44%	73%	68%	89%	42%
% FSP	51%	76%	83%	72%	82%	47%	52%	37%	85%	87%	50%	55%	84%	72%	66%	90%	96%	95%	88%
% of total gaspereau harvest (by number) alewife	47%	46%	71%	24%	62%	45%	33%	36%	63%	66%	62%	77%	62%	37%	53%	64%	45%	17%	17%

Table 5. Blueback catch-at-age (number of fish, thousands) from the Miramichi River fishery, 1982 to 2000. Age.FSP = total age.age at first spawning. Total equals total catch at age (all spawning histories).

		Numbers of blueback (X 1000)																		
Age.FSP		1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	2.2	.	0	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total 2		.	0	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	3.2	.	.	.	45	4	0	.	.	.	.	.	.	.	.	.	.	.	.	.
	3.3	25	56	51	345	541	191	2	4	416	520	130	47	155	78	118	245	3,944	163	147
Total 3		25	56	51	390	545	192	2	4	416	520	130	47	155	78	118	245	3,944	163	147
	4.2	0	3	9	459	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	4.3	0	56	46	651	116	828	300	2	.	35	307	124	90	147	38	1	127	1,051	25
	4.4	410	986	317	2,940	218	3,185	1,363	611	398	1,323	591	171	1,805	4,173	257	607	2,999	9,505	583
Total 4		411	1,046	372	4,050	345	4,013	1,664	613	398	1,358	899	295	1,895	4,321	295	608	3,126	10,556	608
	5.2	39	.	0	62	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	5.3	104	24	19	239	113	31	478	98	23	48	178	24	.	113	61	8	.	1	146
	5.4	270	321	116	791	681	147	2,503	1,424	583	93	404	380	98	1,564	832	15	172	627	1,020
	5.5	179	280	42	177	30	53	405	136	163	106	.	297	466	943	773	33	85	308	1,171
Total 5		592	625	177	1,269	824	231	3,386	1,658	769	247	582	700	564	2,620	1,666	55	257	937	2,338
	6.2	39	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	6.3	58	23	0	84	7	27	.	133	85	51	102	.	.	11	4	8	.	.	9
	6.4	113	97	85	286	149	496	115	1,850	789	286	77	233	625	114	207	79	7	76	94
	6.5	44	114	4	47	25	14	37	84	99	1	5	92	75	91	124	50	23	23	19
	6.6	.	11	.	.	.	.	.	.	.	.	.	7	384	21	31	43	3	2	10
Total 6		254	244	90	416	182	537	152	2,066	972	337	184	333	1,084	237	366	180	32	101	132
	7.2	39	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	7.3	245	.	6	6	1	.	15	.	7	12	48	32	.	.	2	1	3	.	.
	7.4	347	21	10	58	15	173	91	40	219	212	67	61	273	79	22	33	10	.	.
	7.5	130	35	24	47	.	32	.	7	44	13	.	60	.	26	7	35	5	.	.
	7.6	7	13	.	.	.	.	.	.	.	.	.	.	13	.	2	5	.	.	.
	7.7	.	.	.	.	.	.	.	.	.	.	.	53	.	.	.	1	6	.	.
Total 7		767	69	40	111	16	205	106	47	269	237	115	206	287	105	33	75	24	.	.
	8.2	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	8.3	0	9	6	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	8.4	26	115	26	12	10	.	7	.	15	46	7	83	.	7	2	.	4	.	.
	8.5	19	34	6	.	.	43	.	0	.	.	.	43	.	.	1	4	8	.	.
	8.6	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total 8		45	161	39	12	15	43	7	0	15	46	7	126	.	7	3	4	12	.	.

Table 5 (continued).

Numbers of blueback (X 1000)

Age.FSP	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
9.3	0	.	4	54	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
9.4	59	15	10	49	.	.	.	0	2	.	.	21	.	.	.	0	.	1	.
9.5	19	0	2	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
9.7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total 9	79	15	16	124	1	.	.	0	2	.	.	21	.	.	.	1	1	.	.
10.3	0	.	.	.	6	.	.	.	.	.	.	.	.	.	.	1	1	1	.
10.4	.	24	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
10.5	1	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total 10	1	30	4	.	6	.	.	.	.	.	.	61	.	.	.	.	.	.	.
11.3	.	.	.	.	.	.	.	.	.	.	.	61	.	.	.	.	.	.	.
11.4	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total 11	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
12.3	.	.	.	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
12.4	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total 12	.	.	4	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	2,174	2,248	791	6,393	1,942	5,220	5,317	4,389	2,841	2,748	1,917	1,789	3,984	7,368	2,481	1,167	7,397	11,757	3,224
Dominant Cohort	1975	1979	1980	1981	1981	1983	1983	1983	1984	1987	1988	1988	1990	1991	1991	1993	1995	1995	1995
(%)	35%	47%	47%	63%	42%	77%	64%	47%	34%	49%	47%	39%	48%	59%	67%	52%	53%	90%	73%
% FSP	28%	59%	52%	54%	41%	66%	33%	17%	34%	71%	38%	32%	70%	71%	48%	80%	95%	85%	59%
% of total gaspereau harvest (by number)																			
blueback	53%	54%	29%	76%	38%	55%	67%	62%	37%	34%	38%	23%	38%	63%	47%	36%	55%	83%	83%

Table 6. Estimated catches of gaspereau at index trapnets in the Miramichi estuary (Millbank), and in each of the branches for 1976 to 2000. Counts are for the entire migration period.

	Estuary	Northwest	Southwest	
Year	Millbank	Index	Enclosure	Millerton
1976	88,000			
1977	184,000			
1978	133,000			
1979	113,000			
1980	76,000			
1981	44,000			
1982	35,000			
1983	54,000			
1984	39,000			
1985	66,000	79,000	101,000	
1986	41,000	79,000	94,000	
1987	40,000	29,000	100,000	
1988	51,000			
1989	18,000			
1990	20,000			
1991	24,000			
1992	40,000	136,000	75,000	
1993		65,000	40,000	
1994		38,000	66,000	
1995		81,000	131,000	151,000
1996				72,000
1997				119,000
1998				150,000
1999				202,000
2000				66,000

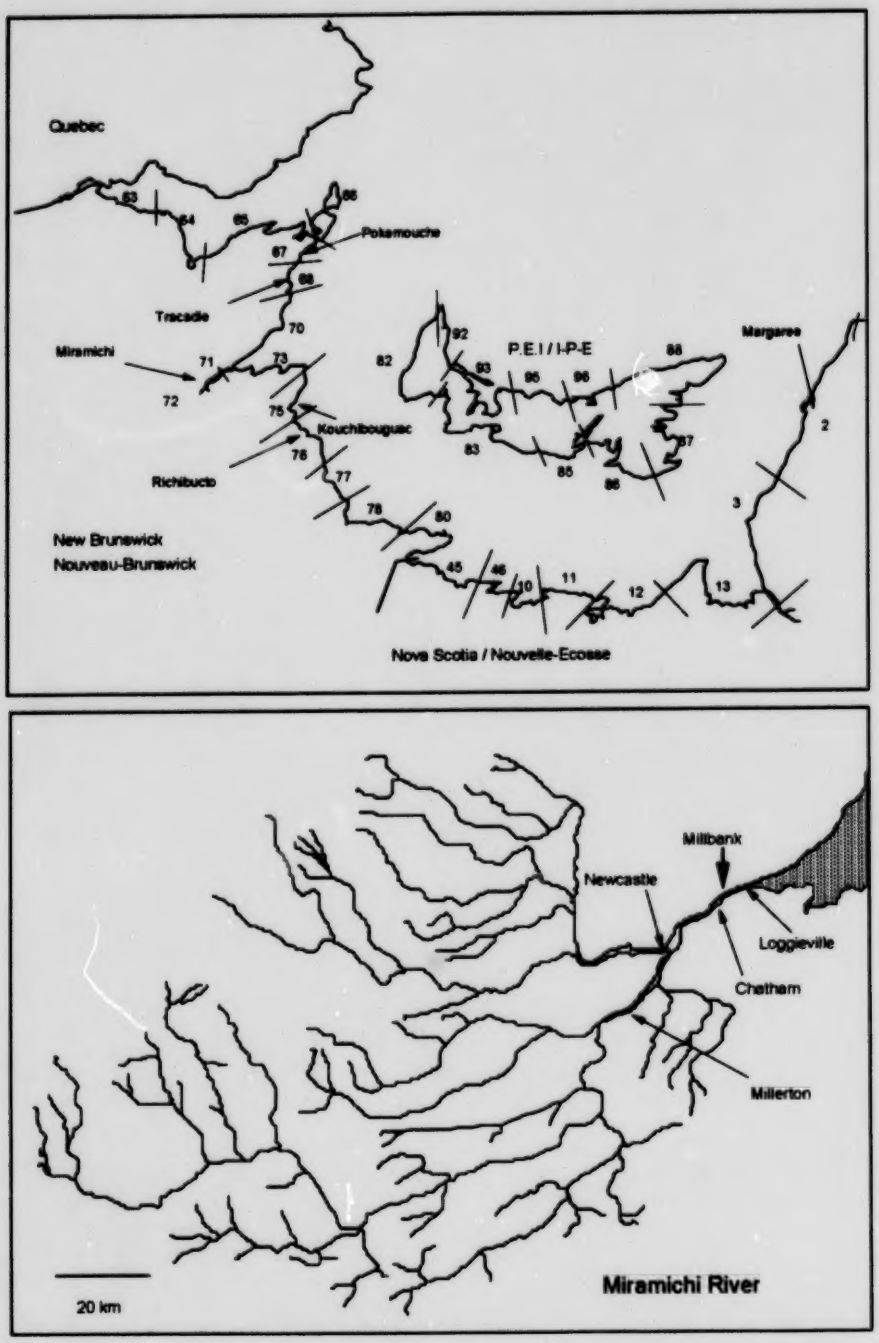


Figure 1. Statistical districts, rivers and place names referenced in the document.

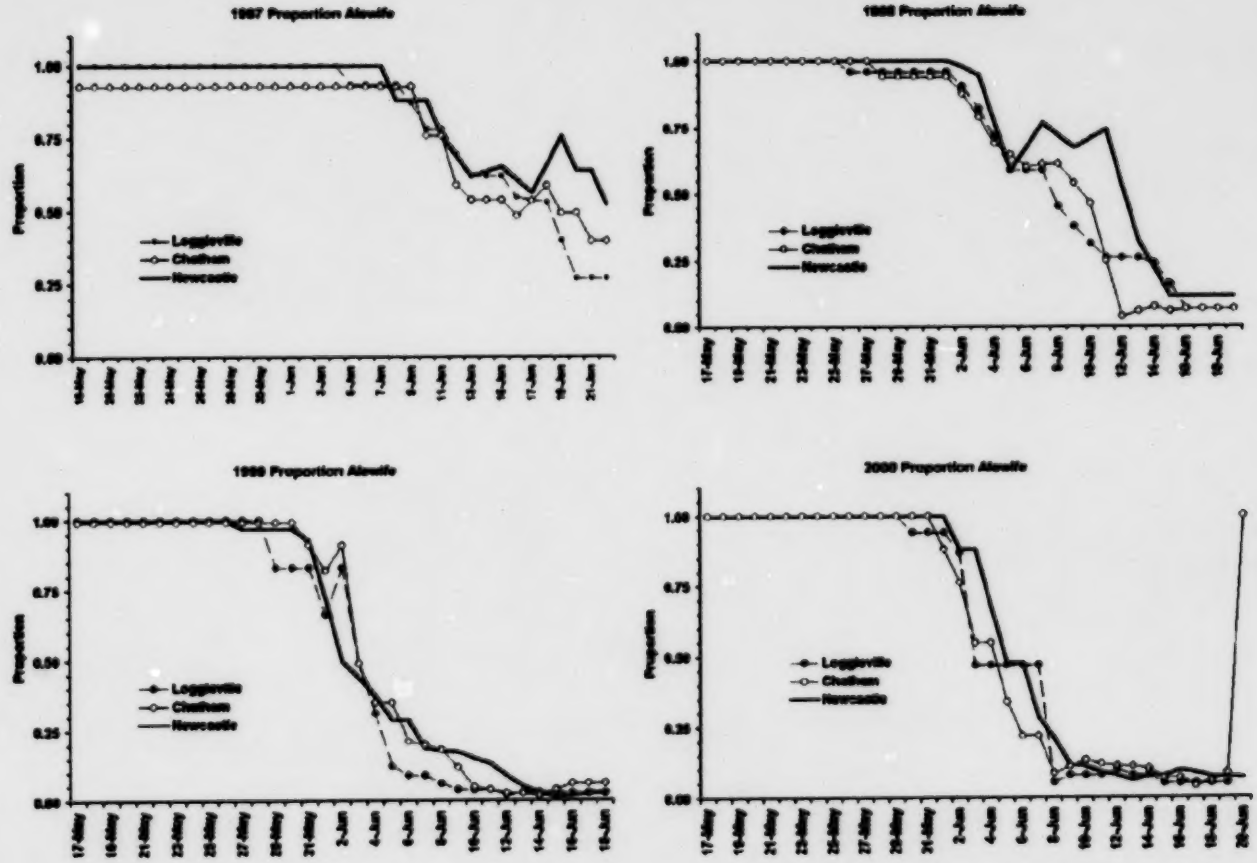


Figure 2. Proportion alewife in the harvests from the three main fishing areas in the Miramichi River in 1997 to 2000.

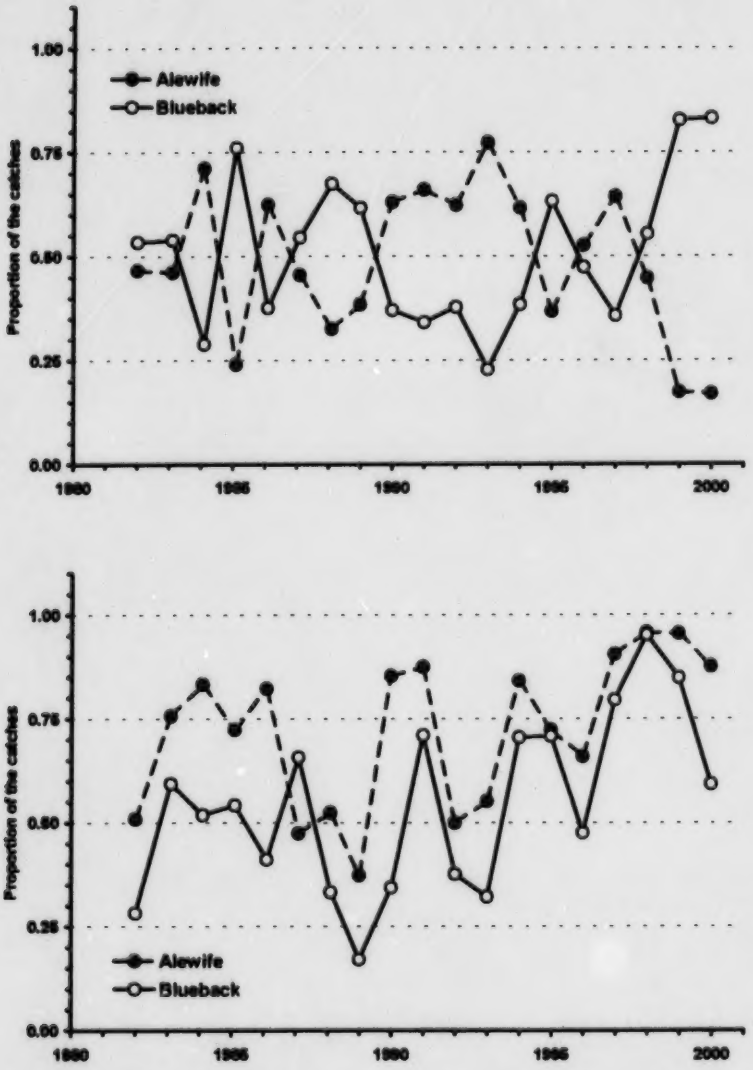


Figure 3. Relative proportions (by number) of alewife and blueback herring in the catch (upper) and proportion of the catches (by number) which were first time spawners (FSP) (lower) in the gaspereau fishery of the Miramichi River, 1982 to 2000.

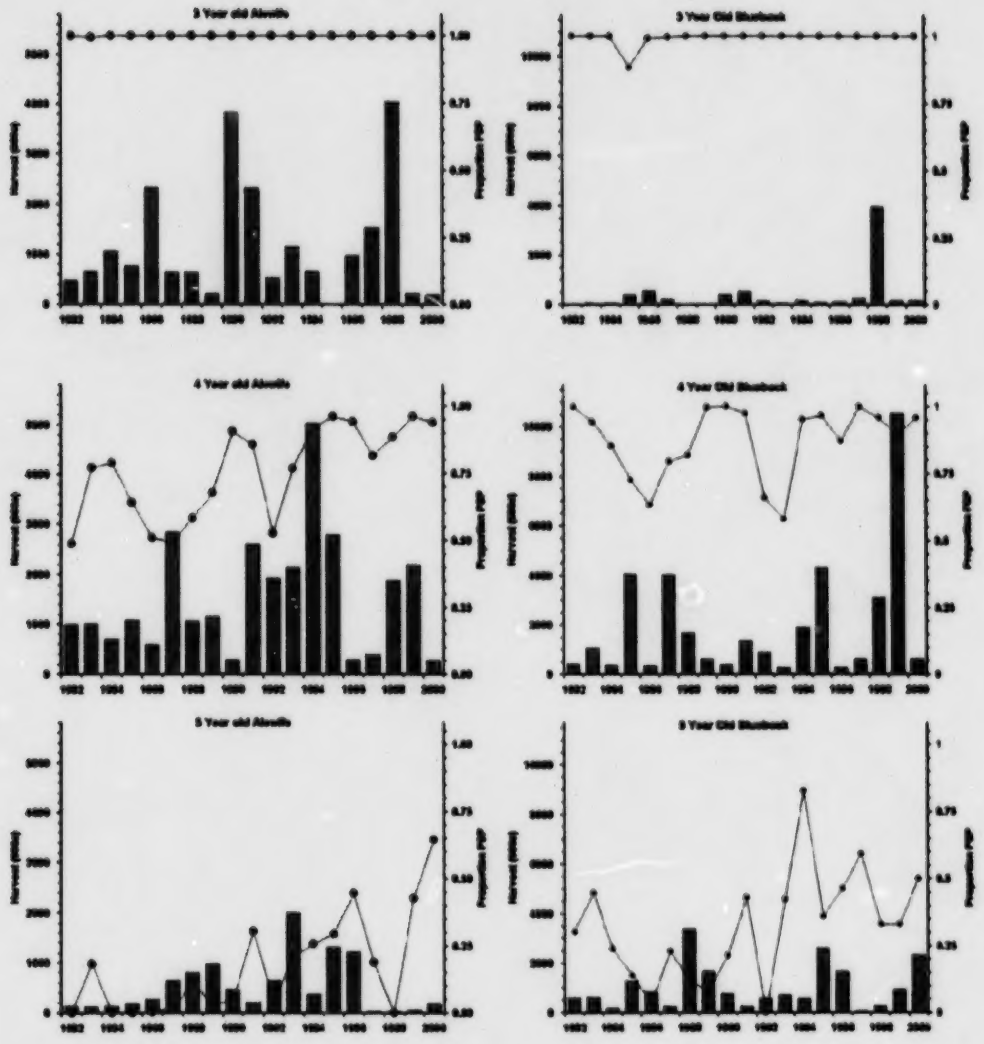


Figure 4. Harvest number at age (thousands) (bars) and proportion of the harvest which was first time spawners (FSP) (line) of alewife (left panels) and blueback (right panels) in the commercial catch of the Miramichi River, 1982 to 2000.

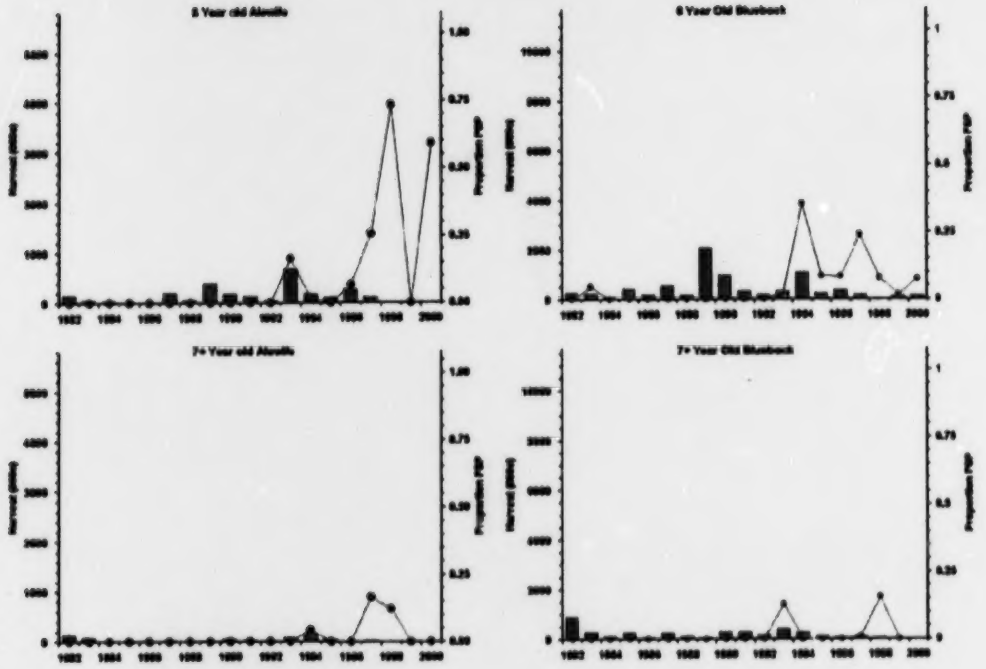


Figure 4 (continued).

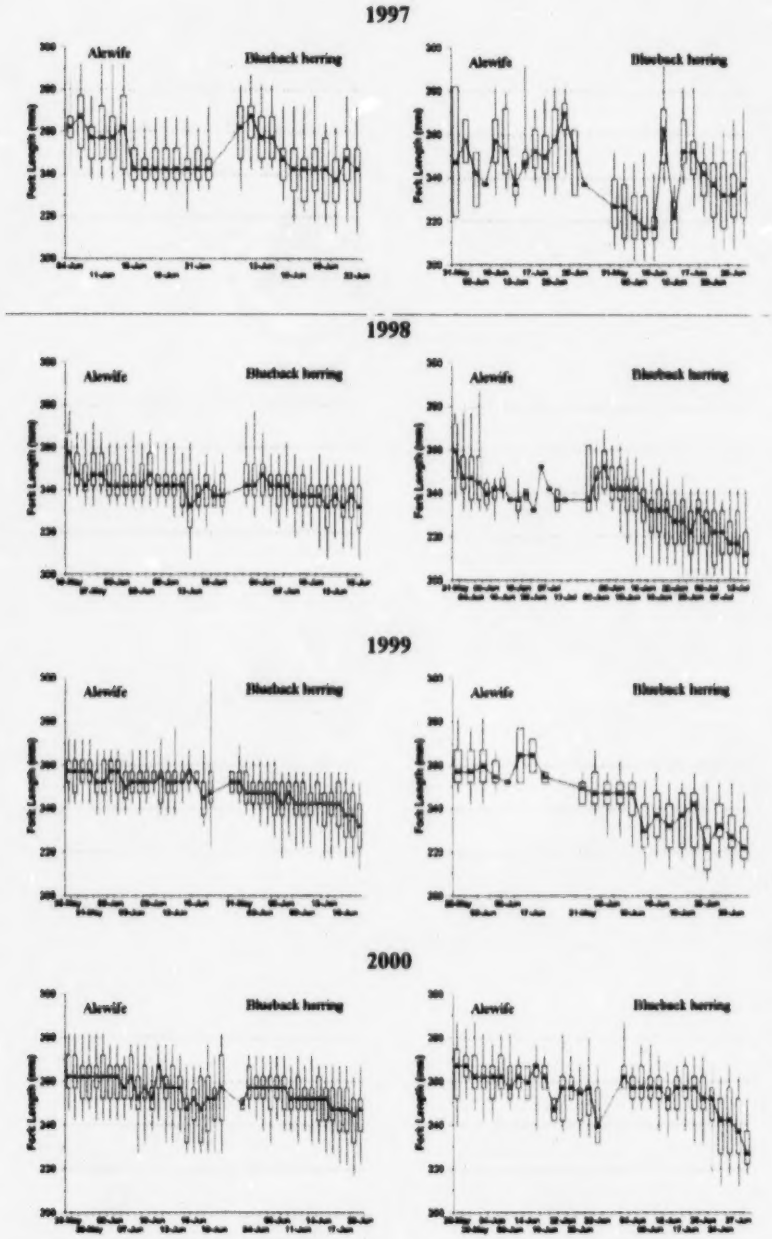


Figure 5. Changes in length distributions of alewife and blueback herring over the fishing season (commercial fishery – left panels) and for the entire migration period (Millerton Science trapnet – right panels) during 1997 to 2000.

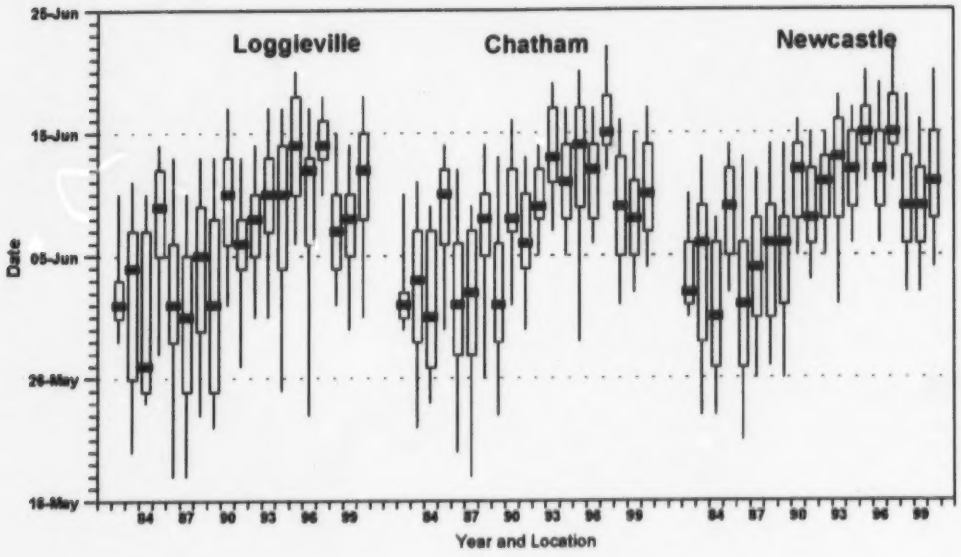


Figure 6. Timing of the gaspereau catches of the Miramichi River by fishing area, 1982 to 2000. Data are from logbook reports. Solid square is the median date of the landings, rectangles encompass the interquartile range (25% to 75%) of landings, vertical lines encompass the 5% to 95% range of landing dates.

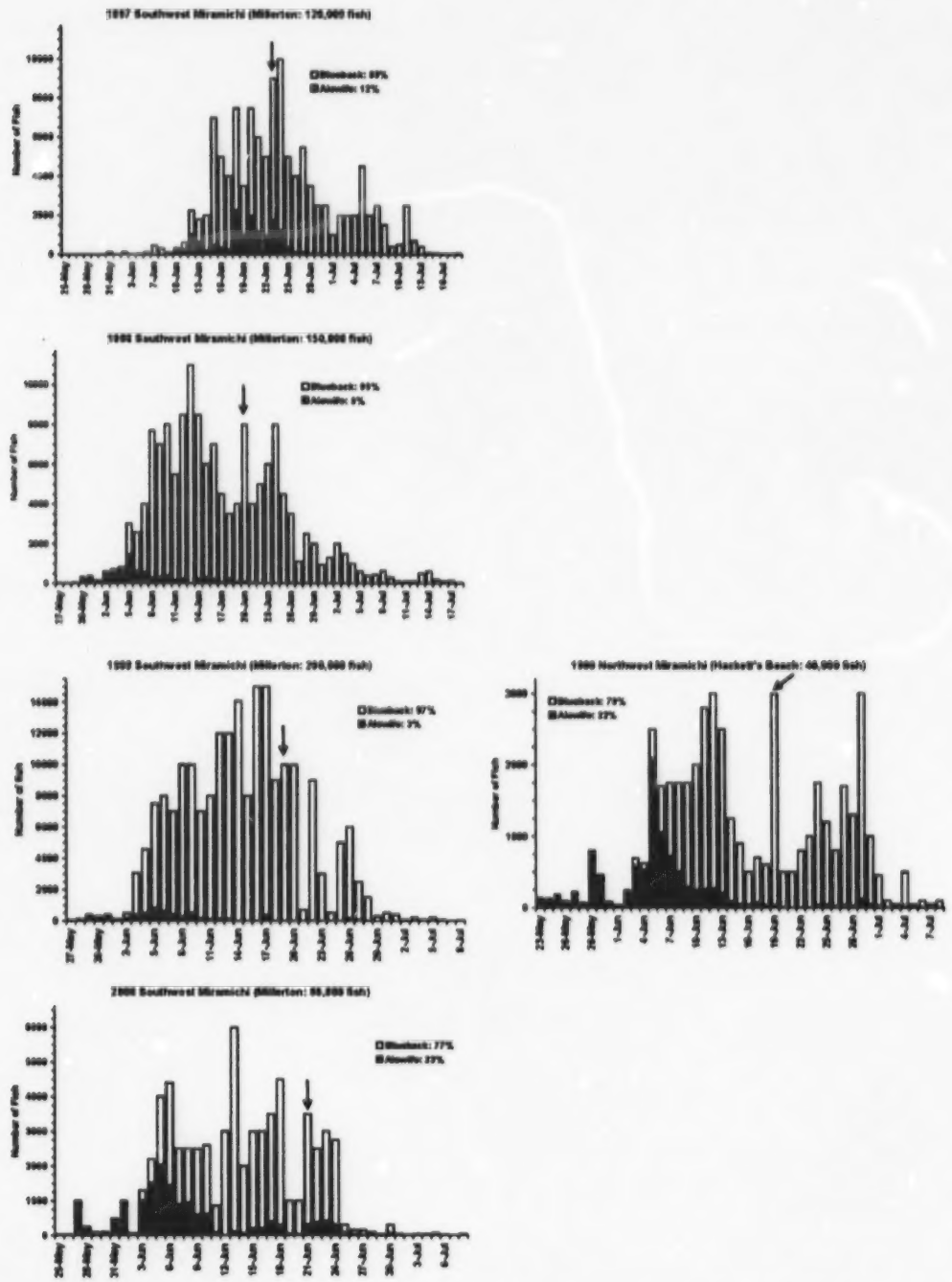


Figure 7. Relative abundance of alewife and blueback herring at research trapnets in the Southwest Miramichi (left) and Northwest Miramichi (right). The inverted arrow identifies the date of closure of the gaspereau commercial fishery.

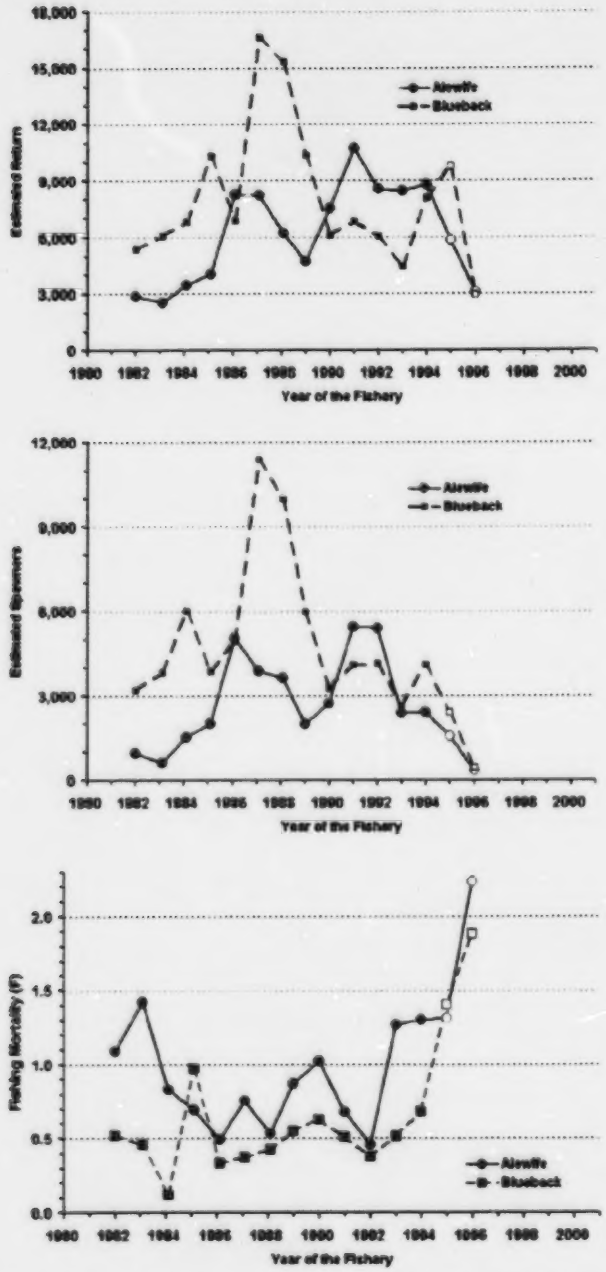


Figure 8. Estimated run size (upper), spawning escapement (middle) and fishing mortality rates (lower) on alewife and blueback herring in the Miramichi River gaspereau fishery, 1982 to 1996. Estimates are from cohort analysis at an assumed M = 0.4. The open symbols in the panels represent years for which the estimates are partial.

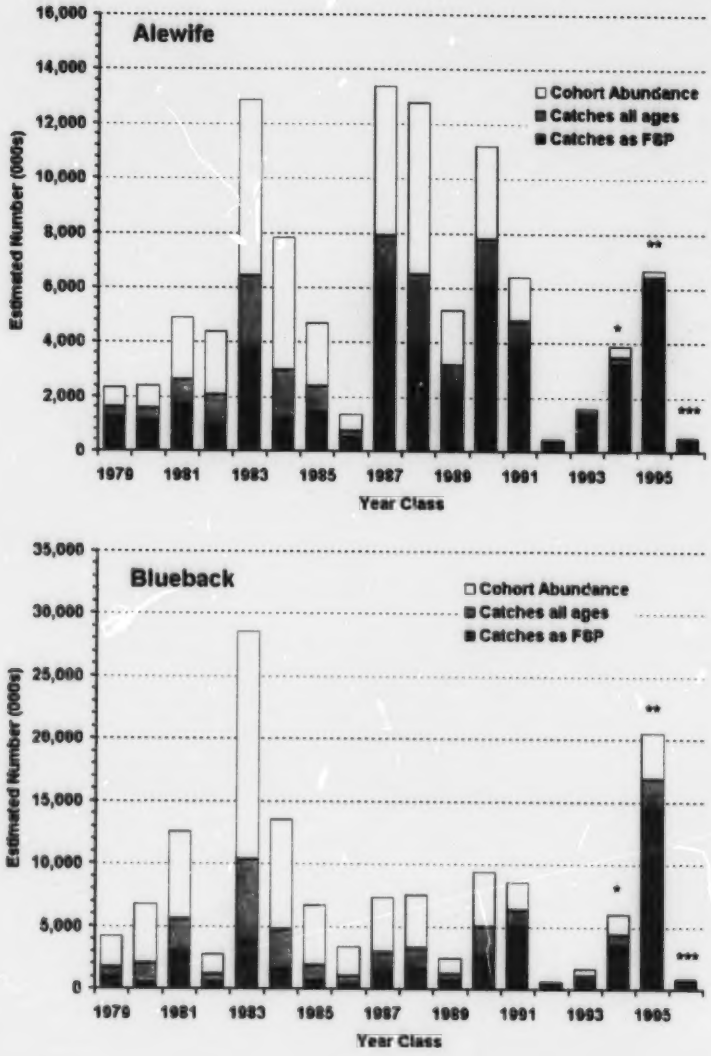


Figure 9. Estimated size of alewife (upper) and blueback (lower) year classes in the Miramichi River. The solid portion of the bar represents the number of fish of the cohort harvested as first time spawners, the top of the grey bar defines the total number of fish of the cohort harvested and the top of the white bar defines the estimated abundance of the cohort as returns to the river. The asterisks over the bars from 1994 to 1996 indicate the estimates are incomplete.

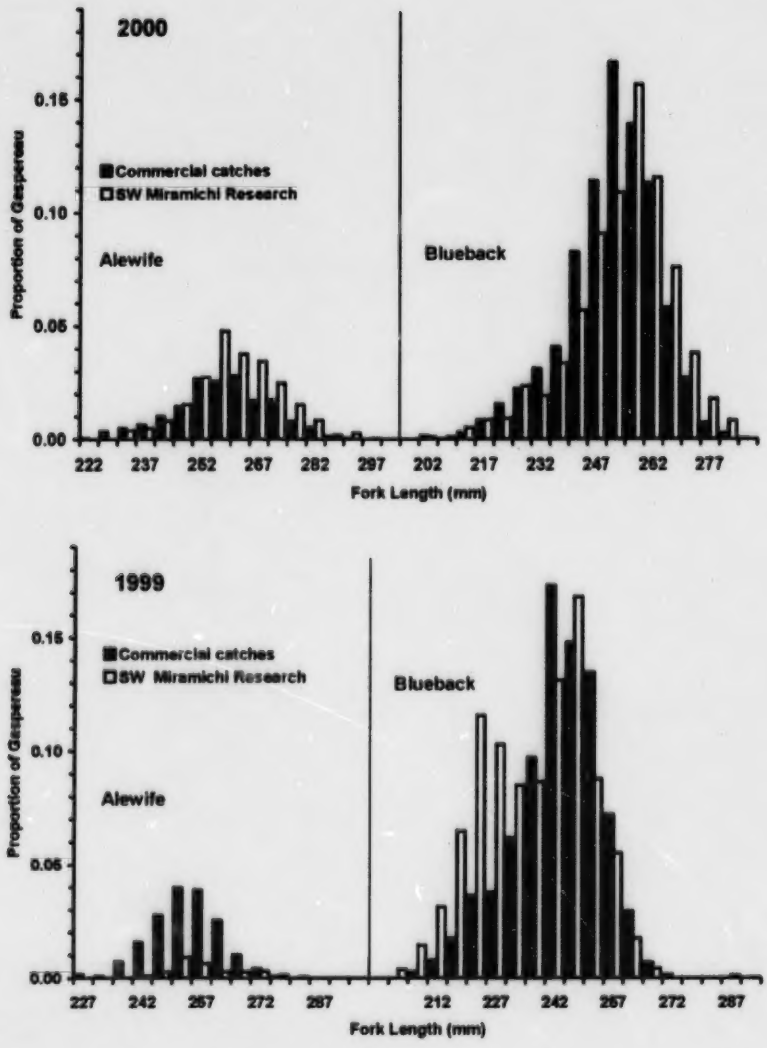


Figure 10. Proportion at length by species in the commercial catches and the research trapnet in the Southwest Miramichi, 1997 to 2000.

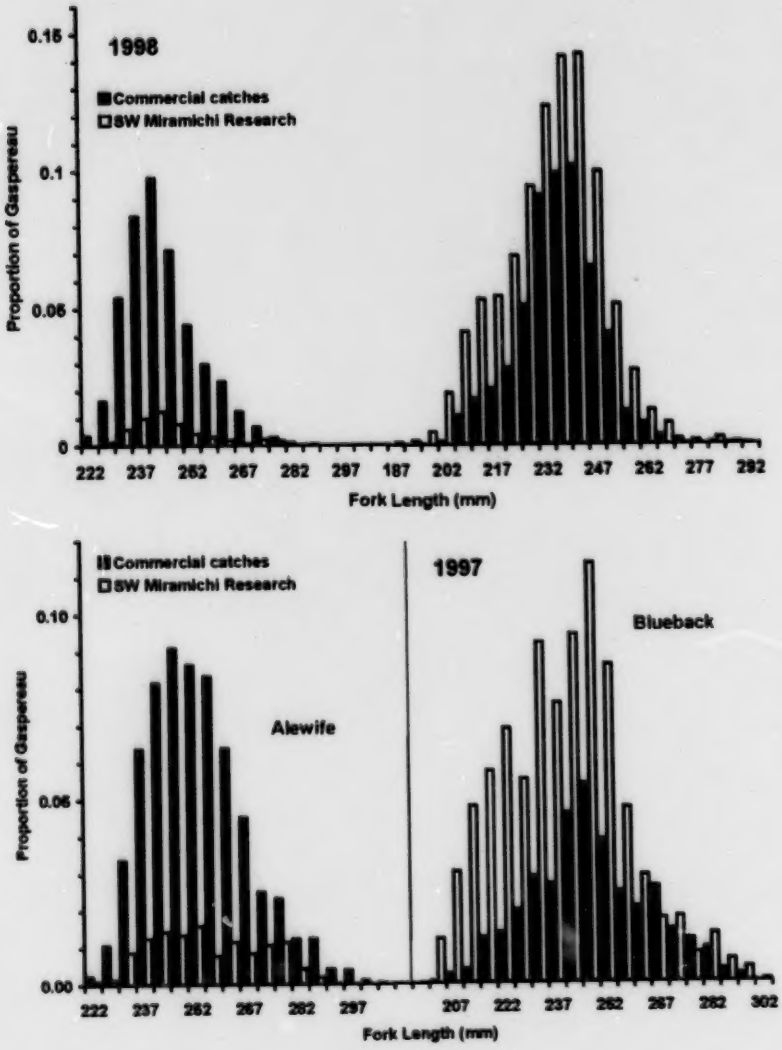


Figure 10 (continued).

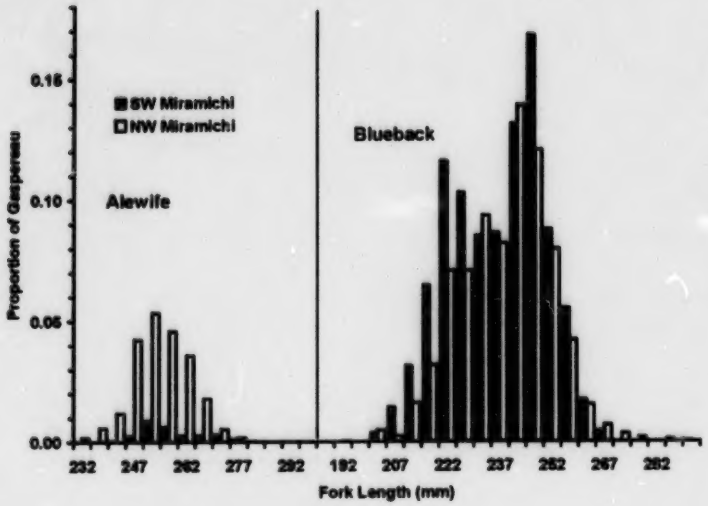
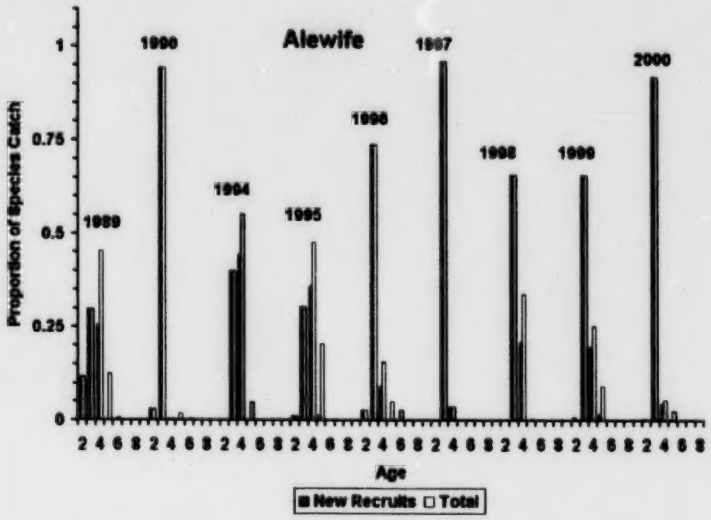
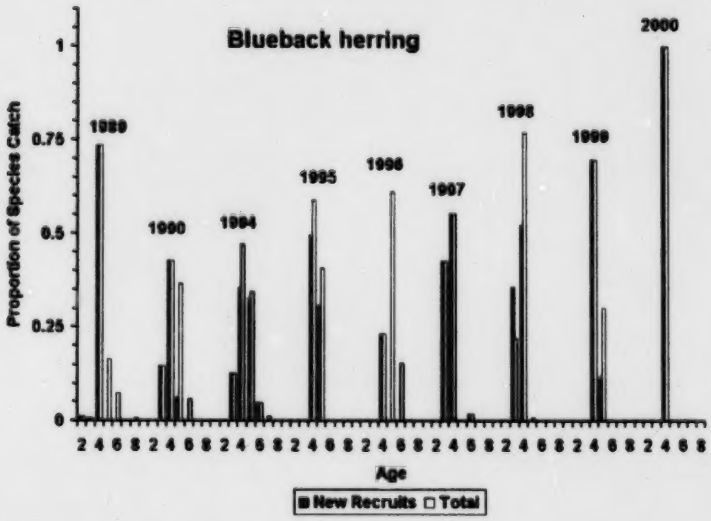


Figure 11. Proportion at length by species in the research trapnets from the Southwest Miramichi (Millerton) and the Northwest Miramichi (Hackett's Beach) in 1999.





	1989	1990	1994	1995	1996	1997	1998	1999	2000
% Alewife	75%	89%	75%	70%	96%	90%	82%	88%	99%
				% New Recruitment					
Alewife	67%	98%	84%	69%	86%	100%	87%	88%	97%
Blueback	75%	64%	86%	80%	23%	100%	88%	81%	100%

Figure 12. Proportion at age in the alewife and blueback herring catches from the Richibucto River gaspereau fisheries, 1989, 1990, and 1994 to 2000.